# NISTTech

## Polymerizable Biomedical Composition

**Imparts anti-bacterial properties to common dental resins**

## Description

Researchers at the National Institute of Standards and Technology (NIST) together with the American Dental Association are keeping your teeth healthier in between trips to the dentist's office. Dental fillings cover cavities, or small holes in teeth caused by bacterial decay of the tooth enamel. Untreated, cavities may grow and cause teeth to hurt and eventually fall out. Dentists widely use durable resins for dental fillings. Dentists cure these resins using ultraviolet light to form a hard filling that resembles the color of surrounding teeth. Unfortunately, dental resins may slightly shrink after time, and become brittle at the edges. The edges of these fillings can break or form tiny pockets or fissures at the edges through normal wear and tear. Food and bacteria can get caught in the tiny fissures causing new or secondary cavities. NIST researchers have developed a novel type of polymer additive for dental resins that will kill bacteria before they can grow in these fissures.

Polymers are long chains of hydrocarbons that have various chemical groups attached to them, giving distinct properties. NIST researcher Joseph Antonucci thought to attach functional groups having antimicrobial effects to these long chains to produce a polymer capable of killing bacteria on contact. Researchers hypothesize the functional groups are effective because they disrupt or destroy bacterial membranes that they touch. These functional groups are believed to be tightly attached to the polymers and will stay incorporated in the dental fillings. The new polymers produced by this technique exhibit antimicrobial properties that last for longer than a year without diminishing. Joseph Antonucci, NIST researcher, noted “This polymer is very easy to make, using inexpensive materials and a simple, one step reaction that is well understood by most chemists. The polymer readily mixes with common dental resins, and dentists can still use the same curing techniques that they already use.”

## Applications

- **Dental resins**
  Easily mixes with existing dental resins.
- **Dental**
  May be used for resins, restoratives, adhesives, sealants, and denture, endodontic materials.
- **Biomedical**
  May be extended to bone cements and maxillo-facial materials.

## Advantages

- **Long-lasting**
  May extend the life of dental resins by reducing secondary caries.
- **Easy to Manufacture**
  Simple, one step manufacturing process.
- **Easy to use**
  Mixes readily with common dental resins.

## Abstract

Polymers with quaternary ammonium functional groups in their molecular structures constitute an important class of biocidal materials. Because of the widespread incidence of dental caries there is a need for effective anti-bacterial polymeric dental and biomedical materials, e.g., restorations, adhesives, sealants, endodontic materials, denture and maxillofacial materials, and bone cements. For example, a major cause for the clinical failure of composite restorations is bacterial infiltration at the filling-tooth interface, which leads to secondary or recurrent caries and requires the replacement of the filling and removal of the carious tooth structure. One approach to prevent the occurrence of recurrent caries is to use polymeric materials with anti-microbial properties. In this research it is demonstrated that the classical, facile Menschutkin reaction can be adapted to the synthesis of multi-functional, thermosetting monomers and resins that have one or more quaternary ammonium groups in their chemical structures.

## Inventors

- Antonucci, Joseph M.

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